

Europäisches Patentamt
European Patent Office
Office européen des brevets



(11) **EP 1 139 614 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
04.10.2001 Bulletin 2001/40

(51) Int Cl.7: **H04L 12/56**

(21) Application number: **00302526.9**

(22) Date of filing: **28.03.2000**

(84) Designated Contracting States:
**AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU
MC NL PT SE**
Designated Extension States:
AL LT LV MK RO SI

(71) Applicant: **LUCENT TECHNOLOGIES INC.**
Murray Hill, New Jersey 07974-0636 (US)

(72) Inventors:
• **Demetrescu, Cristian**
Twickenham, Middlesex TW2 5LY (GB)
• **Samaras, Konstantinos**
Swindon, Wiltshire SN2 2HL (GB)

- **Samuel, Louis Gwyn**
Swindon, Wiltshire SN2 3YG (GB)
- **Sandell, Magnus**
Swindon, Wiltshire SN1 3PN (GB)
- **WU, Jian Jun**
Reading, Berkshire (GB)
- **Yan, Ran-Hong**
Farington, Oxon SN7 7SS (GB)

(74) Representative: **Williams, David John et al**
Lucent Technologies UK Limited,
5 Mornington Road
Woodford Green, Essex IG8 0TU (GB)

(54) **Improved method of decoding uplink status flags for RT-EGPRS users**

(57) In the GPRS, a method of decoding uplink status having reduced interleaving depth in a RLC/MAC block is proposed; for RT-EGPRS users, all of the uplink flag bits are provided in the first burst of the four bursts; and for EGPRS users, nine bits of the uplink status flags

are provided in the first burst of the RLC/MAC block and the remaining bits in the next three bursts. On receiving the first nine bits, a mobile performs an autocorrelation to identify the USF whether it belongs to the EGPRS or to the RT-EGPRS group.

EP 1 139 614 A1

Description

[0001] This invention relates to a method of decoding Uplink Status Flags (USFs) in a telecommunications service such as the Real-Time General Packet Radio Service (RT-GPRS).

[0002] Digital mobile communication systems for voice, such as the Global System for Mobile Communications (GSM) and Digital Advanced Mobile Systems (DAMPs) have expanded very quickly in recent years. Systems for data, such as the GPRS and Enhanced Data rate for GSM Evolution (EDGE) and Universal Mobile Telecommunications System (UMTS), are being developed rapidly, as wide acceptance of the Internet creates a substantial demand. Voice over the fixed packet switched network is being developed and it is expected that there will be an increasing volume of voice traffic using Internet Protocol (IP) networks. Potential demand for voice services over GPRS/Enhanced GPRS (EGPRS)/EDGE is expected to increase.

[0003] In GPRS and EGPRS/EDGE, in current arrangements, a Radio Link Control/Medium Access Control (RLC/MAC) block is interleaved over four Time Division Multiple Access (TDMA) bursts in four consecutive time frames. Consequently the USFs are also interleaved over four TDMA bursts, and a USF field cannot be decoded until all four TDMA bursts are received. This leads to a twenty millisecond USF field decoding delay, which in a voice service may not be acceptable.

[0004] It has been proposed in a co-pending patent application of the current applicant that one or more USF fields can be sent in one RLC/MAC block in the downlink, depending on the scheme to transmit such blocks. It has also been proposed in another co-pending application of the current applicant that the USF fields are transmitted only in the first burst, so that the polling algorithm is optimized and the mobile reply time is reduced. If the mobile reads its own USF in the first burst, then in the same twenty millisecond period (if the mobile is active) the mobile sends a voice packet on the corresponding uplink traffic channels. Unfortunately, when the USF fields are moved to the first burst, the interleaving depth is reduced from four bursts to one burst. This degrades the Block Error Rate (BLER) of the USF by about six dB.

[0005] This is illustrated in Figure 1 which is a plot of the BLER of the USF against E_b/N_0 using block code (36, 3); Typical Urban (TU) 50 is used and there is no Frequency Hopping (FH). The line E on Figure 1 is a plot for a four burst interleaving in EDGE 8 PSK (Phase Shift Key) and the line V is a plot for voice over EDGE 8 PSK with one burst interleaving. The loss of about 6 dB is clear.

[0006] It is an object of the invention to provide a method to offset this loss due to reduced interleaving depth.

[0007] According to the invention, in the general packet radio service telecommunications system, a method of decoding uplink status flags having reduced interleaving depth in a radio link control/medium access control block is characterized by:-

selecting a first plurality of uplink status flags and providing all of the flag bits in the first block of said group of bursts;
selecting a second plurality of uplink status flags and providing a predetermined number of bits of the uplink status flags in the first burst of said group of bursts and the remaining bits in the other bursts of the group.

[0008] Also according to the invention, a general packet radio service system comprising a plurality of base transceiver stations; a plurality of radio network controllers; and a core network; characterized in that in each base transceiver station is arranged to code uplink status flags for a first group of voice users by providing all of the bits of the uplink status flag in the first burst of said radio link control/medium access control block, and for a second group of voice users by providing a predetermined number of bits in the first burst of said radio link control/medium access control block and the remaining bits in subsequent bursts.

[0009] Further according to the invention, a mobile terminal in a RT-EGPRS system in which each mobile terminal is associated with a first or a second group of users, and is arranged to perform an autocorrelation on a predetermined number of bits in a uplink status flag received from the first burst in said radio link control/medium access control block, whereby said terminal determines whether that uplink status flag is associated with the same group of voice users as said terminal.

[0010] In the drawings, Figure 1 illustrates the problem to be solved. The invention will be described by way of example only with reference to Figures 2 to 5 in which :-

Figure 2 is a highly schematic illustration of a part of the general packet radio service system;
Figures 3a, 3b and 3c are three different autocorrelations of the first nine bits of uplink status flags;
Figure 4 shows a correlation of the whole 36 bits of uplink status flags; and
Figure 5 illustrates performance of old and new coding methods.

[0011] In Figure 2, in the GPRS 10, a Mobile User (MU) 12 is in a telecommunications cell controlled by a Base Transceiver Station (BTS) 14 which in turn is controlled by a Radio Network Controller 16 (RNC). The RNC is connected

to a Core Network (CN) 18. The BTS 14 receives voice signals from the MU 12, forms them into RLC/MAC blocks, and the blocks are transferred through the GPRS 10 to the other party to a call.

[0012] Table I illustrates block coding schemes currently used.

TABLE I

USFs before block encoder

000	USF1
001	USF2
010	USF3
011	USF4
100	USF5
101	USF6
110	USF7
111	USF8

USFs after block encoder

Usf1 = [0 0];
 Usf2 = [1 1 1 1 0 0 0 0 1 1 1 1 0 0 0 0 1 1 1 1 1 0 0 0 1 1 1 1 1 0 0 0 1];
 Usf3 = [1 1 1 0 0 1 1 1 0 1 1 1 0 1 1 1 0 0 1 1 0 0 0 0 1 1 0 1 1 0 0 0 1 1 0 0];
 Usf4 = [1 0 0 1 1 1 1 0 0 1 1 0 0 0 0 0 1 1 1 0 1 1 1 0 1 1 1 0 0 1 0 0 1 1 1 1];
 Usf5 = [0 0 0 1 1 0 0 1 1 0 0 1 0 1 1 0 1 0 1 0 0 0 0 1 1 0 1 1 1 1 1 1 1 1 1 0];
 Usf6 = [1 1 0 1 0 1 0 1 1 0 0 0 1 1 0 1 0 1 0 1 1 1 0 1 0 1 1 1 0 0 1 0 1 0 1 1];
 Usf7 = [0 0 1 0 0 1 1 0 1 1 0 1 1 1 1 1 1 0 1 1 0 1 0 0 0 1 0 0 1 1 1 0 1 0 0];
 Usf8 = [0 1 1 0 1 0 1 1 1 0 1 0 1 0 1 1 1 1 0 0 0 1 1 1 1 1 0 0 1 0 0 1 0 0 1 1].

[0013] Considering now only the first nine bits of each encoded USF; these are given in Table II.

TABLE II

Usfb1 = [0 0 0 0 0 0 0 0 0];
 Usfb2 = [1 1 1 1 0 0 0 0 1];
 Usfb3 = [1 1 1 0 0 1 1 1 0];
 Usfb4 = [1 0 0 1 1 1 1 0 0];
 Usfb5 = [0 0 0 1 1 0 0 1 1];
 Usfb6 = [1 1 0 1 0 1 0 1 1];
 Usfb7 = [0 0 1 0 0 1 1 0 1];
 Usfb8 = [0 1 1 0 1 0 1 1 1].

[0014] The eight USFs can be formed into two groups; one group comprises uncoded USFs of which the last bit is one; this group will be referred to as the EGPRS group. The other group comprises uncoded USFs of which the last bit is zero (See Table I) and this group will be referred to as the RT-EGPRS.

[0015] The two groups are shown in Table III.

TABLE III

EGPRS	001	USF2
	011	USF4
	101	USF6
	111	USF8
RT-EGPRS	000	USF1
	010	USF3
	100	USF5
	110	USF7

In the inventive arrangement, the system shown in Figure 2 is arranged so that, when the RLC/MAC blocks are formatted, the EGPRS USFs are interleaved in four consecutive bursts, as in the prior art arrangement. However, the RT-EGPRS USFs are all placed in the first burst.

[0016] On receipt of a first burst, a mobile user 12 in the EGPRS/RT-EGPRS system performs an autocorrelation of the first nine bits of the received USF, to determine whether the USF is directed to EGPRS users or to RT-EGPRS users; autocorrelation of the nine bits will provide a definite peak at the relevant USF. The user 12 can then identify which of the eight USFs is present.

[0017] Figures 3a, 3b and 3c are examples of autocorrelation functions for the eight USFs. In Figure 3a there is a marked peak for USF1, indicated on the graph by a diamond shape, while the other seven USFs show either no peak or much lower peaks. In Figure 3b, the peak is associated with USF2, indicated by a square; and in Figure 3c the peak is associated with USF3 indicated by a triangle.

[0018] If the user 12 is an RT-EGPRS user, and identifies one of USFs 1, 3, 5 or 7, the mobile then looks for the remaining 27 bits in the first burst. If the user 12 is an EGPRS user and identifies one of the USFs 2, 4, 6 or 8, the mobile then looks for the remaining 27 bits in the next 3 bursts.

[0019] As a further confirmation measure, both types of users can be arranged to perform a further correlation using the full 36 bits of the relevant USF sequence. A typical 36 bit correlation is shown in Figure 4; the peak for USF 1, indicated by diamond... is illustrated. This second correlation is used as confirmation of the earlier 9-bit correlation.

[0020] Once the RT-EGPRS user mobile 12 has recognized its USF with certainty, the last bit is known. Block decoding apply (36, 2) instead of (36, 3) as in the prior art, can be used. Such block coding is described in our co-pending patent application number filed on even date.

[0021] Figure 5 is a plot of BLock Error Rate(BLER) against Es/No in dBs for four block decoding methods; block decoding (36, 3) minimum distance 20 is indicated by the line 20; (36, 2) minimum distance 20 is indicated by the line 22; (48, 3) minimum distance 27 is indicated by the line 24; and (48, 2) minimum distance 27 is indicated by the line 26.

[0022] Using the same code words, a gain of about 4 dBs can be achieved by using (36,2) instead of (36, 3) block decoding. If new block code is introduced and (48, 2) block code with the same minimum distance as (48, 3) code can be used with the same minimum distance, then a gain of about 5dBs can be achieved in comparison with the (36, 3) block code. A major part of the degradation of the BLER has been compensated.

Claims

1. In the general packet radio service telecommunications system, a method of decoding uplink status flags having reduced interleaving depth in a radio link control/medium access control block is **characterised by:-**

selecting a first plurality of uplink status flags and providing all of the flag bits in the first block of said group of bursts;
selecting a second plurality of uplink status flags and providing a predetermined number of bits of the uplink status flags in the first burst of said group of bursts and the remaining bits in the other bursts of the group.

2. A method according to Claim 1 in which the first plurality of uplink status flags all have a first common feature and the second plurality of uplink status flags all have a second common feature.

3. A method according to Claim 2 in which the first common feature is that the third bit of an uncoded uplink status flag is a one and the second common feature is that the third bit of an uncoded uplink status flag is a zero.

4. A method according to any preceding Claim in which one plurality of uplink status flags is associated with a first group of mobile users and the other plurality of uplink status flags is associated with a second group of mobile users.

5. A method according to Claim 4 in which the first and second groups of mobile users are respectively users in the Enhanced General Packet Radio Service and in the Real Time Enhanced General Packet Radio Service.

6. A General Packet Radio Service comprising a plurality of base transceiver stations 14; a plurality of radio network controllers 16; and a core network 18; **characterised in that** each base transceiver station 14 is arranged to decode uplink status flags for a first group of voice users by providing all of the flag bits in the first burst of the radio link control medium access control block, and for a second group of voice users by providing a predetermined number of bits in the first burst of the radio link control medium access control block and the remaining bits in subsequent bursts.

EP 1 139 614 A1

7. A mobile terminal for use in a system according to Claim 6 in which each mobile terminal is associated with a first or a second group of voice users, and is arranged to perform an autocorrelation on a predetermined number of bits in a uplink status flag received from the first burst of the radio link control medium access control block, whereby said terminal determines whether that uplink status flag is associated with the same group of voice users as said terminal.

7. A mobile terminal according to Claim 6 in which said predetermined number of bits is nine.

8. A mobile terminal according to Claim 6 or Claim 7 in a first group and arranged so that, on determination that a received uplink status flag is associated with the first group, the terminal receives the remaining bits of the uplink status flag from said first block.

9. A mobile terminal according to Claim 6 or Claim 7 in the second group and arranged so that, on determination that a received uplink status flag is associated with the second group, the terminal received the remaining bits of the uplink status flag from the subsequent blocks of said group.

10. A mobile terminal according to Claim 8 or Claim 9 further arranged to perform a further autocorrelation on the whole number of received uplink status flag bits

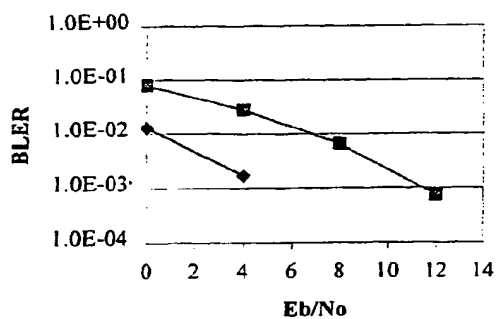


FIG. 1

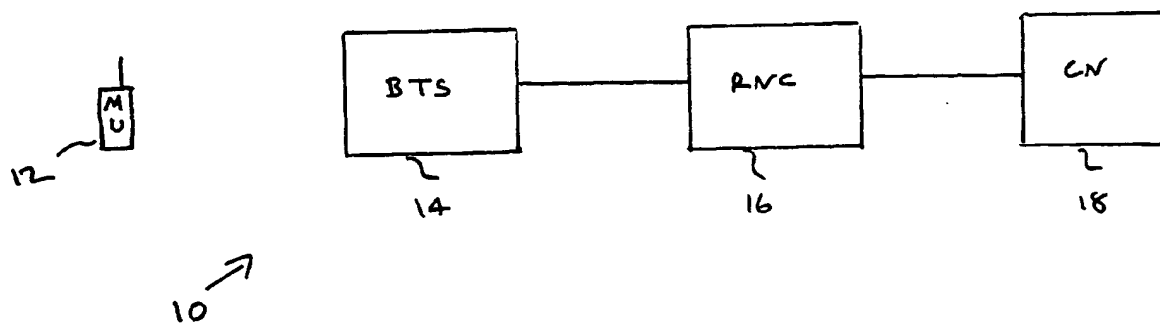


FIG. 2

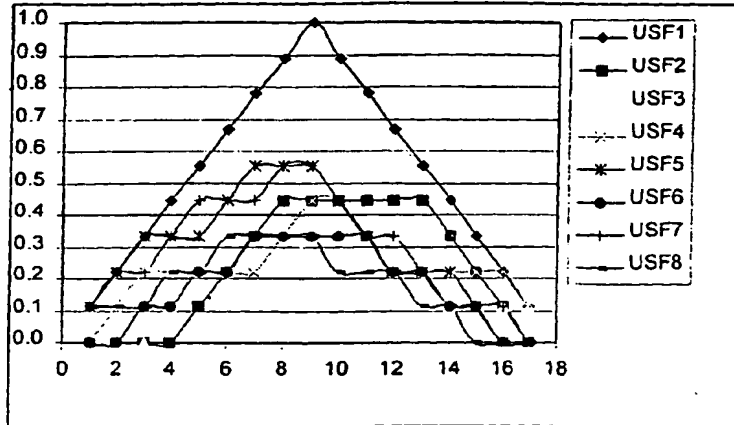


FIG. 3a

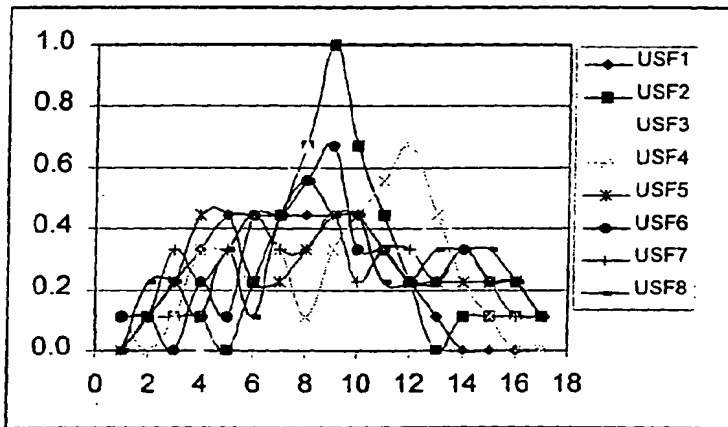


FIG. 3b

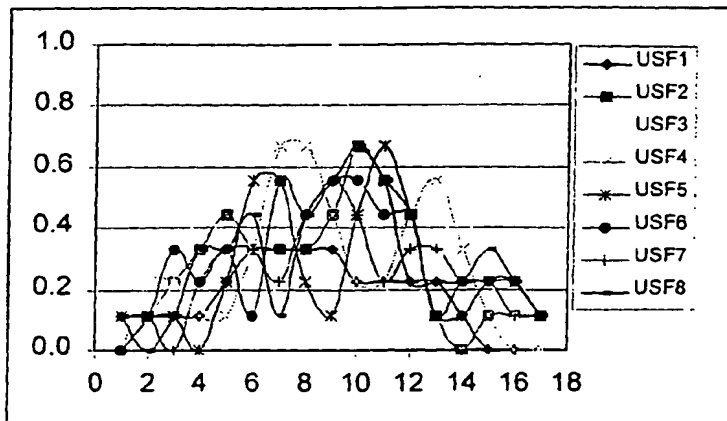


FIG. 3c

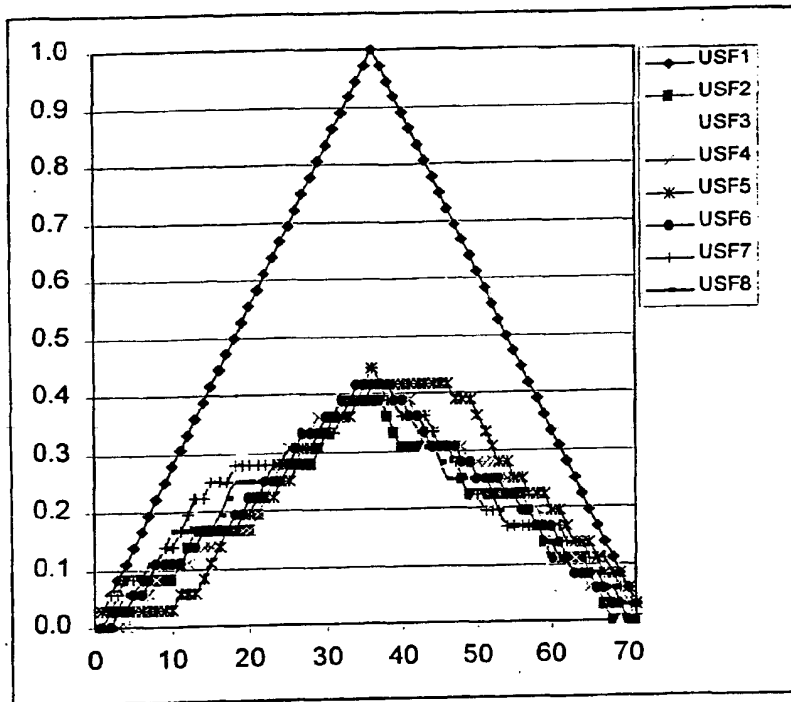


FIG. 4

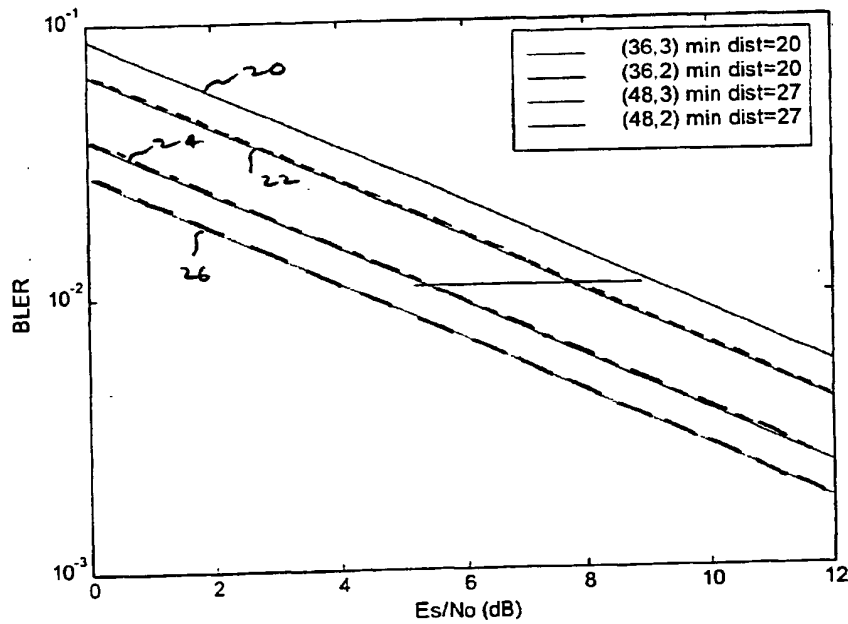


FIG. 5



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 00 30 2526

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A	WO 99 41918 A (ERICSSON TELEFON AB L M) 19 August 1999 (1999-08-19) * abstract * * page 1, line 7 - page 6, line 18 * * page 9, line 10 - line 27 * * claim 1 *	1,6	H04L12/56
A	US 5 910 949 A (BILSTROEM LARS ET AL) 8 June 1999 (1999-06-08) * column 1, line 4 - column 11, line 19 * * column 12, line 39 - column 13, line 26 *	1,6	
A	US 5 499 246 A (COOPER ANDREW) 12 March 1996 (1996-03-12) * column 1, line 5 - column 3, line 54 * * column 4, line 13 - column 6, line 24 * * column 7, line 47 - column 8, line 19 * * claims 1-3,12-14 *	1,6	
A	HANNU H. KARI: "GPRS radio interface" INTERNET, 'Online! 11 August 1998 (1998-08-11), pages 1-22, XP002148349 Retrieved from the Internet: <URL:http://www.cs.hut.fi/ihhk/GPRS/lect/r adio/sld001.htm> 'retrieved on 2000-09-22! * page 1 * * page 9 * * page 10 * * page 11 * * page 12 *	1-6	TECHNICAL FIELDS SEARCHED (Int.Cl.7) H04L H04Q
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 25 September 2000	Examiner Vaskimo, K
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03.82 (P04021)

BEST AVAILABLE COPY

EP 1 139 614 A1

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 00 30 2526

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

25-09-2000

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9941918 A	19-08-1999	AU 3281199 A	30-08-1999
US 5910949 A	08-06-1999	AU 713942 B	16-12-1999
		AU 7452596 A	07-05-1997
		BR 9611082 A	13-07-1999
		CA 2234711 A	24-04-1997
		EP 0856236 A	05-08-1998
		JP 11513858 T	24-11-1999
		NZ 321257 A	29-09-1999
		WO 9715165 A	24-04-1997
US 5499246 A	12-03-1996	GB 2260245 A	07-04-1993
		AU 647670 B	24-03-1994
		AU 2458592 A	08-04-1993
		DE 4233089 A	08-04-1993
		ES 2038932 A	01-08-1993
		FR 2683412 A	07-05-1993
		IT 1255845 B	17-11-1995
		JP 5227231 A	03-09-1993
		SE 9202873 A	05-04-1993

EPD FORM 6/95

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82